Bioluminescence Detector for Collaborative User Demonstrations with an Autonomous Underwater Vehicle

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LONG TERM GOALS

Marine bioluminescence until recently has been measured typically with instruments designed with little attention to their intercalibration and to differences in design parameters critical to the significance of the measurements (Case, et al, 1993). This problem was eased by development of the HIDEX and TOWDEX BPs by the Office of Naval Research to provide a standard profiling or towed instrument for the research community and for surveys by the Naval Oceanographic Office. Capable of very high intake rates ensuring statistically reliable capture across the entire population spectrum of luminescent organisms, and with a precisely defined excitation mode, these instruments approach optimal as arbiters of the state of oceanic bioluminescence. They are impractical for many uses owing to their great size and expense. To continue progress in the quantitative study of marine bioluminesence UCSB investigators have developed a functionally analogous series of bioluminescence bathyphotometers (BPs). These are suitable for use on various marine platforms while retaining intercalibration among all in terms of excitation and measurement of mechanically stimulated light. For this purpose the MDDBP, a compact, closed volume BP has been developed at UCSB and extensively demonstrated in moored and profiling modes.

Interest in use of the REMUS AUV (Woods Hole Oceanographic Institution, C. Von Alt) for coastal bioluminescence surveys led us to development of a BP based on the MDDBP for this platform. This instrument was demonstrated on an early model REMUS in collaboration with Dr. David Lapota, SPAWAR Systems Center San Diego. Our ultimate goal is to adapt this BP to the current REMUS configuration while ensuring that it retains its intercalibration with MDDBPs in use on other platforms.

OBJECTIVES

Following successful development, integration, and field testing of a nose cone bathyphotometer for Mark Moline's (Cal. Poly. SLO) REMUS AUV, we have improved the design and are building two REMUS nose cone bathyphotometers for delivery to Marine Systems Branch, SPAWAR Systems Center San Diego and to the REMUS development group, Woods Hole Oceanographic Institution, for their evaluation.

APPROACH

Fabrication of the instruments is in progress with tank tests tentatively scheduled for February 03. Following this the SPAWAR system will be integrated with their guidance and field tests conducted in the Southern California Bight.

WORK COMPLETED

Mechanical and electronics design and integration to the REMUS vehicle was largely in hand and proven in extensive sea tests on the Cal. Poly. REMUS. Construction of the nose cone housing, ductwork, electronics compartment, and measurement chamber is complete. Remainder of the work depends on batch scheduling of the remaining components with other systems in construction for the DURIP Coastal Monitoring System.

RESULTS

We anticipate that these systems will prove as effective as the Cal Poly unit in measuring coastal BL by the Moline group (see Blackwell, et al, in press).

IMPACT/APPLICATIONS

Since the REMUS is now a commercialized and effective vehicle for coastal monitoring, having a bathyphotometer referenced to HIDEX in its instrument suite gives it the potential to contribute to surveys in support of certain naval operations. In the conventional oceanographic milieu it is already proven effective in measuring the detailed vertical structure of bioluminescence.

TRANSITIONS

The recipients of these two instruments obviously govern their ultimate uses. However, the general class of instruments of this type promises economical and detailed measurements of bioluminescence in the coastal regime where monitoring of dinoflagellate BL may give early warning of toxic blooms. BL is also a good and rapid measure of biomass (Lapota. 1998), suggesting that REMUS-BP systems may have a role in general oceanographic studies.

RELATED PROJECTS

1. Coastal Bioluminescence Prediction Network - N00014-02-1-0635

2. AOSN-II: Monterey Bay Predictive Skill Experiment – New ONR initative

REFERENCES

Case. JF, et al (1993) Assessment of Marine Bioluminescence. Naval Res. Rev. 55:31-41

Lapota, D. (1998) Long term and seasonal changes in dinoflagellate bioluminescence in the Southern California Bight. 193pp. Doctoral Thesis, University of California at Santa Barbara.

Blackwell, S., J. Case, S. Glenn, J. Kohut, M. A. Moline, M. Purcell,O.M.E. Schofield and C. VonAlt (in press) A new AUV platform for studying nearshore bioluminescence structure. Proceedings 12th International Symposium on Bioluminescence and Chemiluminescence, (Kricka, L. J. and P. E. Stanley, editors). World Scientific, Singapore.